From: Bruce Zook
To: Bernhart, Michael R
Cc: Eric Lindgren; Gary Marshall
Subject: RE: UV system- Control Program Improvements for Colorado Springs Utilities
Date: Tuesday, May 29, 2018 12:50:56 PM

The UV dose is generally defined by the following equation:

$$D = I \times t \qquad (1)$$

where D = UV dose, $mW \cdot s/cm^2$

I = intensity of UV light, mW/cm^2

t = exposure time, s

This kind of confirmed what I was thinking. The exposure time could vary with the channel depth, but that can be compensated by increasing the intensity. The exposure time and intensity are inversely proportional so a 1% change in channel flow volume (LxWxD) would mean a 1.1% increase in intensity. It seems that this would be extremely easy to program.

I too saw that the channel is stepped down, but the depth of water is not increased by the amount of the step. The level of the water at the surface decreases also. The depth of water at the back end of the channel is about 2-3 inches more than the front end. You fully modeled the flow characteristics at the time of design so the depths are known at each bank and various flow rates. The depth at the last bank is deeper only to overcome pressure drop in flowing past the previous banks in the channel- the pressure drop is proportional to flow.

Maybe I am oversimplifying this but I think you have already modeled the flow dynamics and you have an existing algorithm to compute the intensity output. It should be very simple to build in the appropriate factor for the different banks based on the bank online. In fact, if you have not already done so I would be surprised because you had to do that in order to properly set the intensity for the first 2 banks when they are required to run. I would be very curious to understand how this is a consideration when it is the lead bank but not if it is the lag bank, it seems to me that calculation is identical.

I look forward to your response.

Make it a great day

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From: Bernhart, Michael R [mailto:Michael.Bernhart@suez-na.com]
Sent: Tuesday, May 29, 2018 9:14 AM
To: Bruce Zook <bzook@csu.org>; michael.bernhart@suez.com

Subject: RE: UV system- Control Program Improvements for Colorado Springs Utilities

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Bruce,

I am told the change you would like to see could change levels of disinfection since you have a stepped channel. The module on the influent side of the channel is 5 inches higher than the effluent module. To get a deeper explanation I need R&D to look at this. He has been out on another project but will see if he has returned.

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From: Bruce Zook <bzook@csu.org>
Sent: Tuesday, May 29, 2018 11:06 AM
To: michael.bernhart@suez.com
Subject: RE: UV system- Control Program Improvements for Colorado Springs Utilities

It has been more than 2 weeks so hopefully you guys have been able to consider this more thoroughly by now and have an idea of a workable solution. I would love to hear from you.

Make it a great day

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From: Bruce Zook
Sent: Tuesday, May 15, 2018 11:32 AM
To: 'michael.bernhart@suez.com' <michael.bernhart@suez.com>
Subject: RE: UV system- Control Program Improvements for Colorado Springs Utilities

I only wanted to confirm that you received this, nothing else. Thank you.

Make it a great day

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From: Bruce Zook
Sent: Friday, May 11, 2018 9:18 AM
To: 'michael.bernhart@suez.com' <michael.bernhart@suez.com>
Cc: Eric Lindgren <elindgren@csu.org>; Gary Marshall <gmarshall@csu.org>
Subject: UV system- Control Program Improvements for Colorado Springs Utilities

It was good to talk to you yesterday. I apologize for not getting this out yesterday but you know how things go sometimes.

To follow up with our conversation, above is the descriptive summary for our system. To summarize, here is what we would like to accomplish:

1. The ability to run any one of the 3 banks in a specific channel as the lead. We see several benefits to this:
    a. We can equalize run time on the power supplies to the banks. As it is now one bank is taking over 80% of the run load and the power supplies in the first two banks (3 banks per channel) are going to need to be replaced well ahead of their full use.
    b. We can equalize run times on the bulbs. Again one bank is being heavily used and we are getting good use from those bulbs. The second to come on will be replaced based on the # of strikes, not hours, and the third bank (first in the flow path) see almost no use. In order to move the bulbs it is a major event and challenging to track the bulb location in the existing program.
    c. Similar to a) and b) above the air conditioners on the power supply cabinets are also loaded very differently and the AC on the lead bank are failing at a much higher rate. It would make it much easier to operate if we could select one of the other banks to be the lead if it was operating more reliably. This would allow us to fix any operational issues without missing a beat. I am told now that this is a cumbersome manual activity.
2. We would like to be able to change the setting where a second unit comes on. I am told not that does not occur until the lead bank reaches 100%. Considering the heat load and the degradation of the AC units on the power supplies we would like to be able to set this

ourselves. There are times that we would like to reduce this to 80% or maybe down as low as 70% based on run condition of the equipment. It seems like we should be allowed this operational flexibility.

3. Ability to download bulb run times and strikes from the control system. I am told that right now the only means we have to do this is by walking through the local control panels and writing down the values. This is a limitation in our asset management program.

I look forward to hearing back from you as to the potential improvements you can help us with on our control system. All of it is based on increasing reliability and getting maximum life out of the assets. We understand that some of this may mean that the system operates below its maximum efficiency but operation cost is not dependent solely on the cost of power fed to the unit.

I look forward to your response.

Make it a great day

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